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Miyazawa et al.

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(54) **SHEET MANUFACTURING APPARATUS**

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(58) **Field of Classification Search**
CPC . B27N 1/02; B27N 3/007; B27N 3/04; B27N 3/08; B27N 3/18; B27N 3/183;
(Continued)

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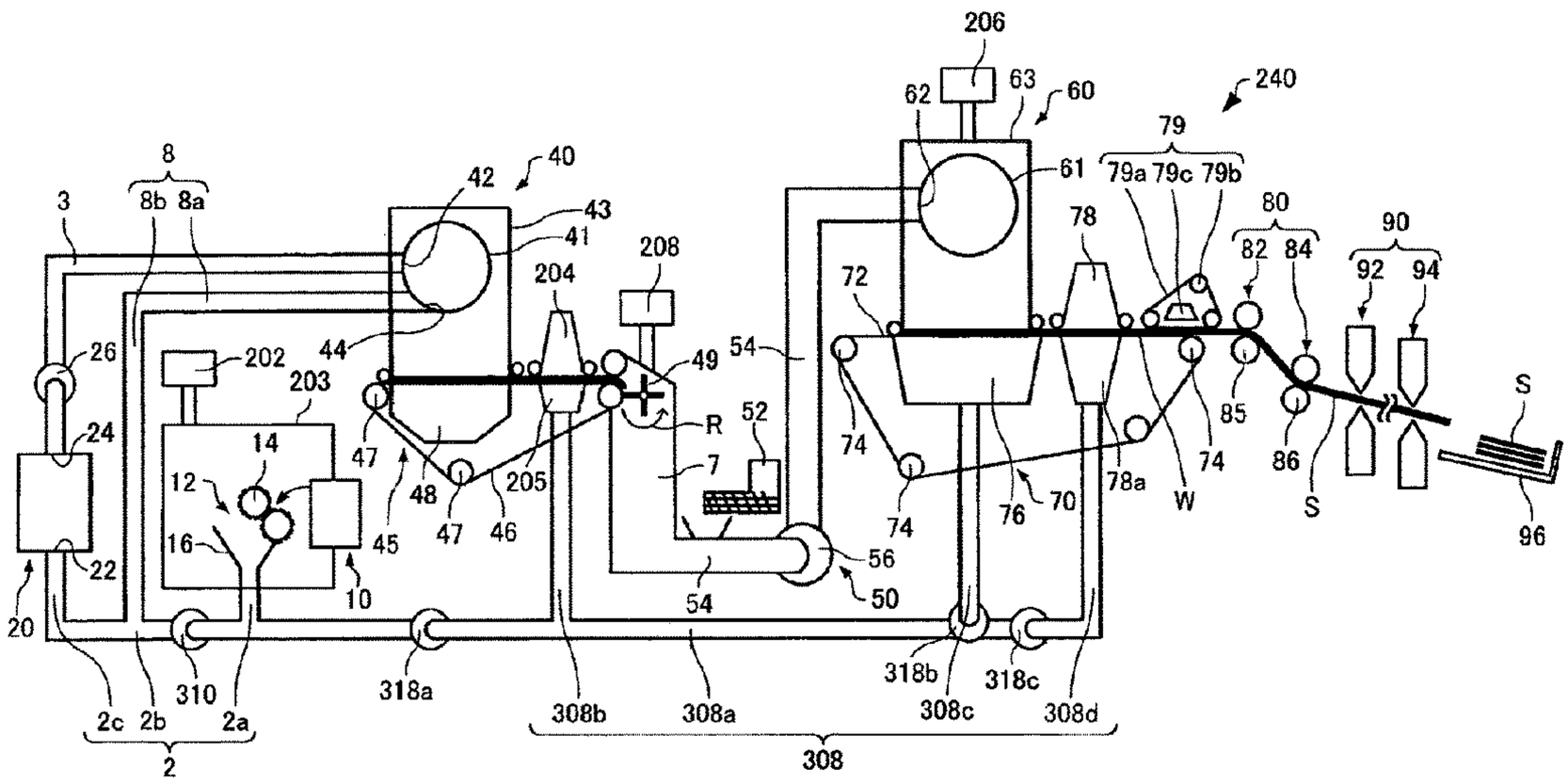
(57) **ABSTRACT**

A sheet manufacturing apparatus includes a coarse crushing portion that crushes a raw material containing a fiber into coarse crushed pieces, a defibrating portion that defibrates the coarse crushed pieces into a defibrated material, a sieve portion that includes a plurality of openings, a sheet forming portion that uses the defibrated material passing through the opening of the sieve portion to form a sheet, and a transport passage that transports the defibrated material, which has not passed through the opening of the sieve portion, between the coarse crushing portion and the defibrating portion.

6 Claims, 8 Drawing Sheets



(51) **Int. Cl.**
D04H 1/72 (2012.01)
D21B 1/06 (2006.01)
D21F 11/00 (2006.01)

(58) **Field of Classification Search**
CPC D04H 1/26; D04H 1/425; D04H 1/60; D04H 1/72; D04H 1/732; D04H 1/736; D21B 1/06; D21B 1/063; D21B 1/08; D21F 9/00; D21F 9/02; D21F 9/04; D21F 11/00; D21F 11/02; D21F 11/06
See application file for complete search history.

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FIG. 1

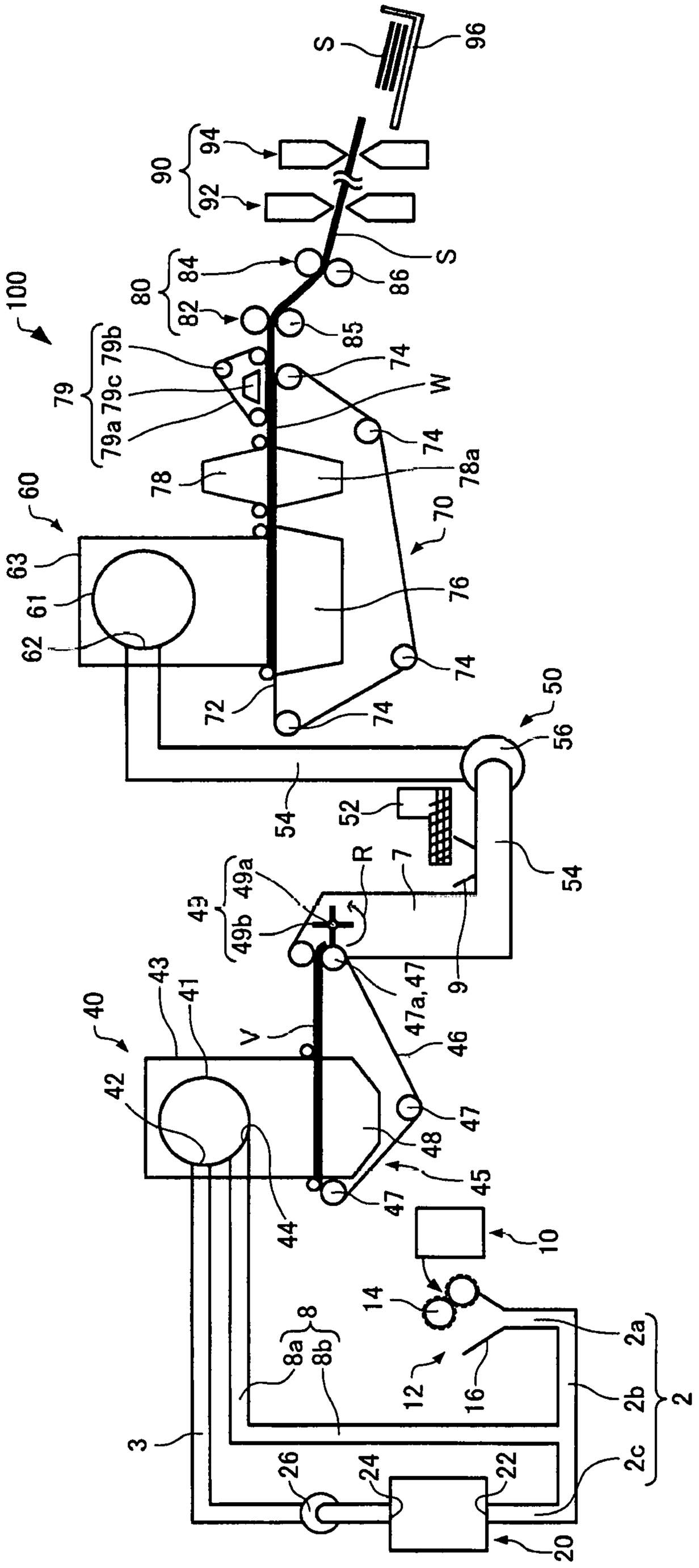
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FIG. 2

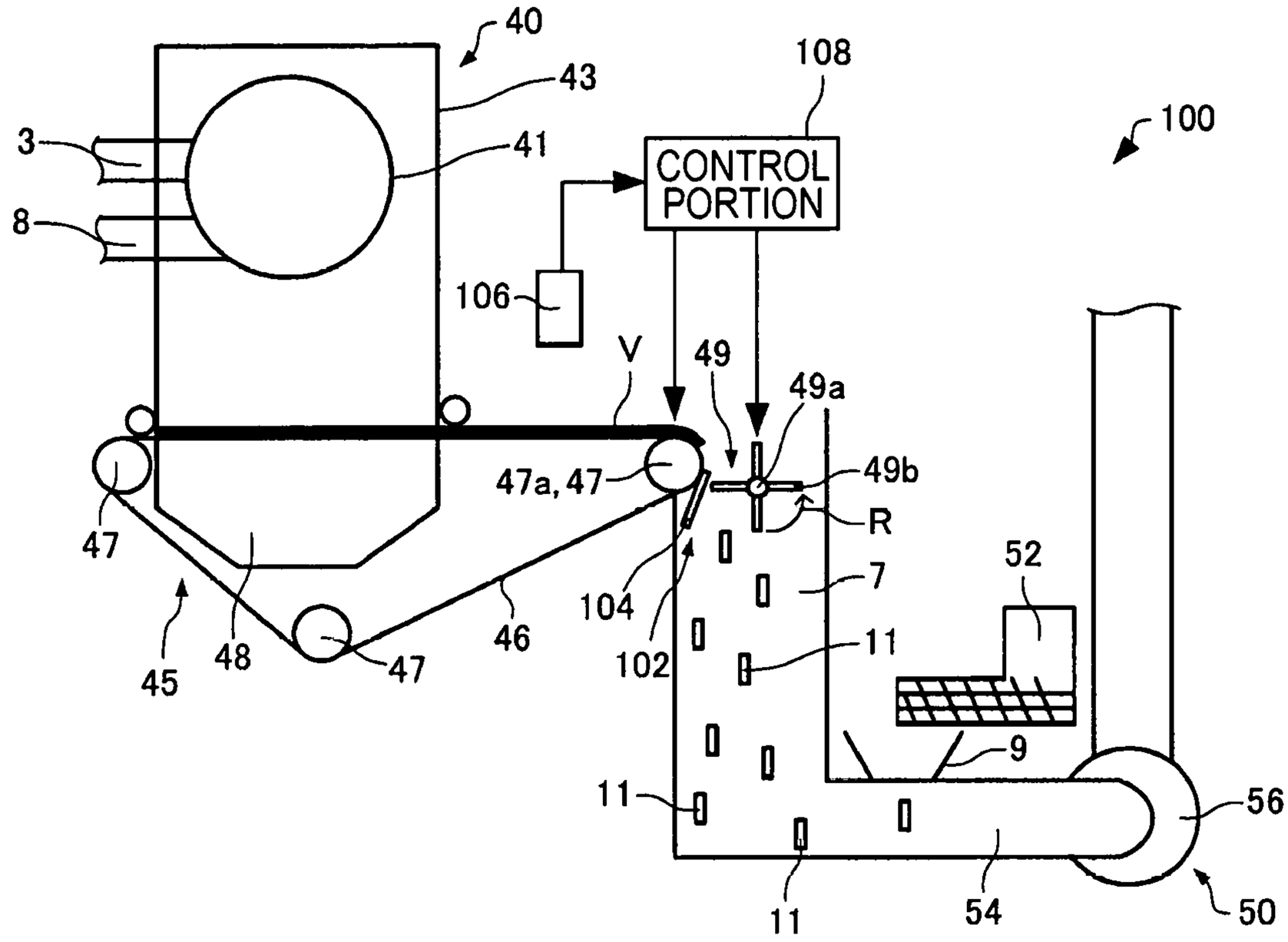
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FIG. 3

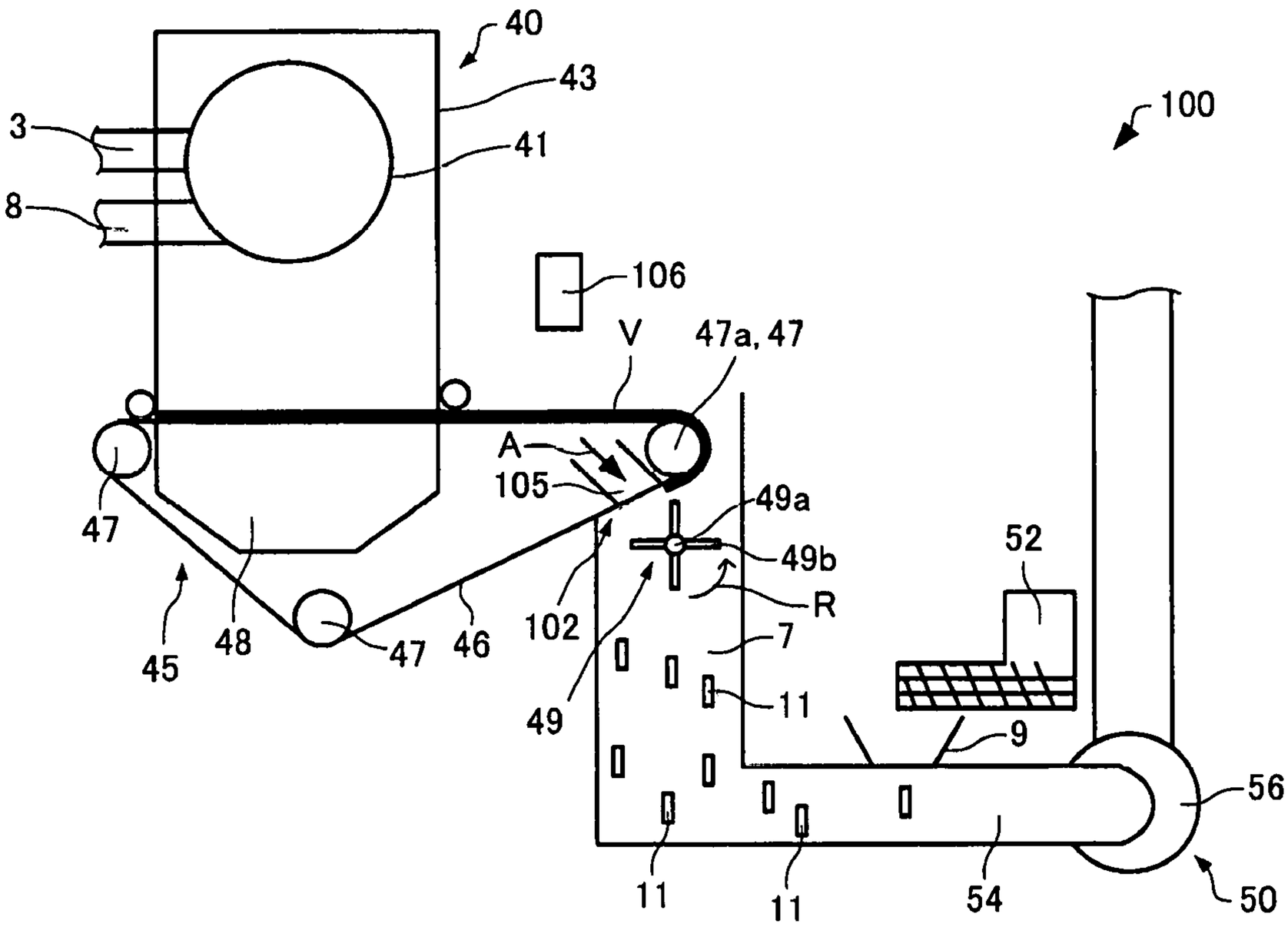
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FIG. 4

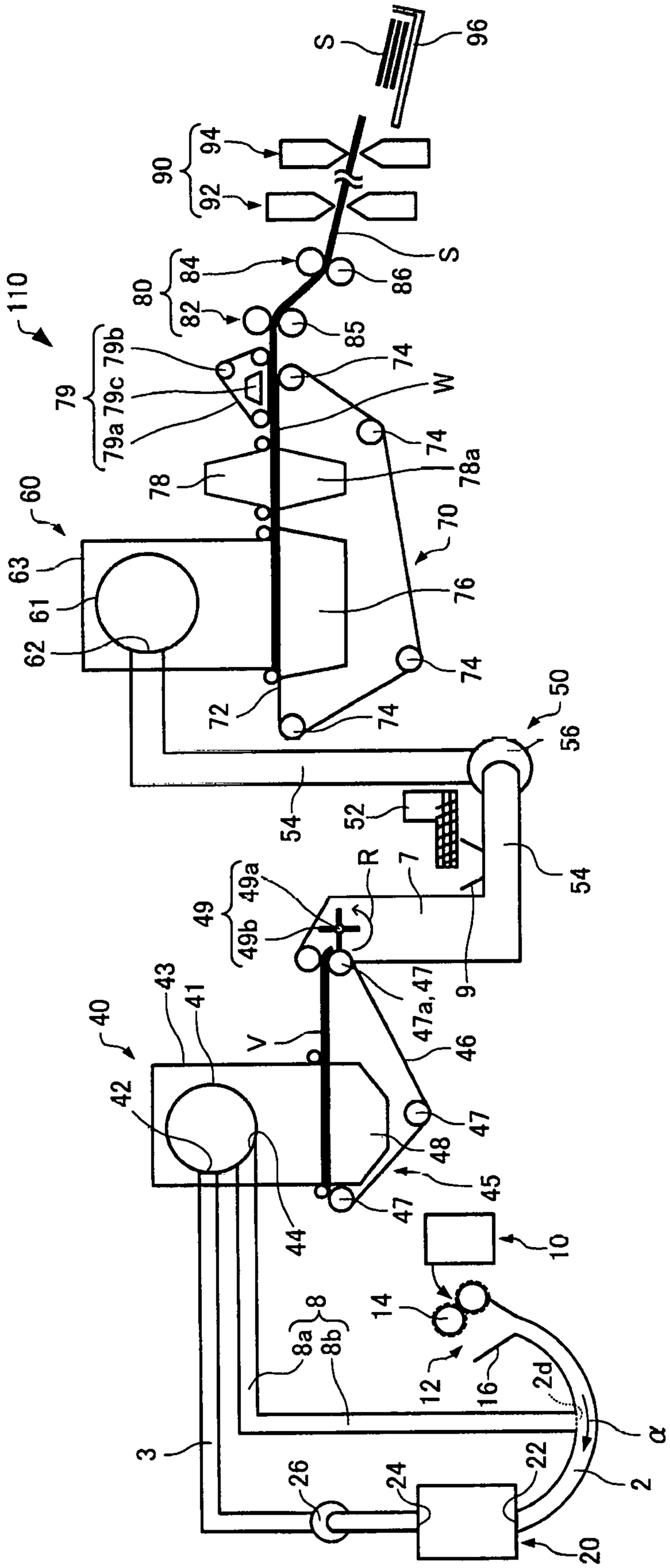
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FIG. 5

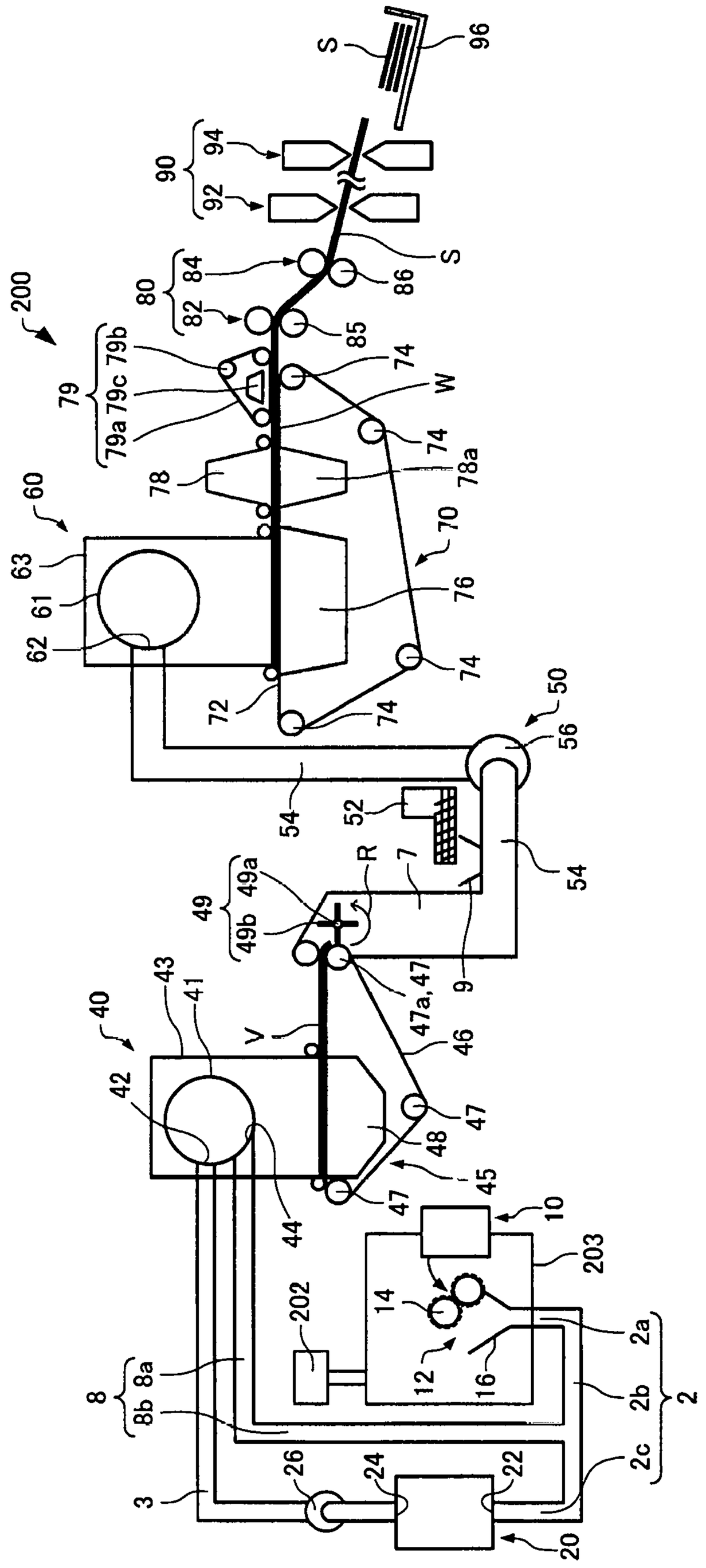
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FIG. 6

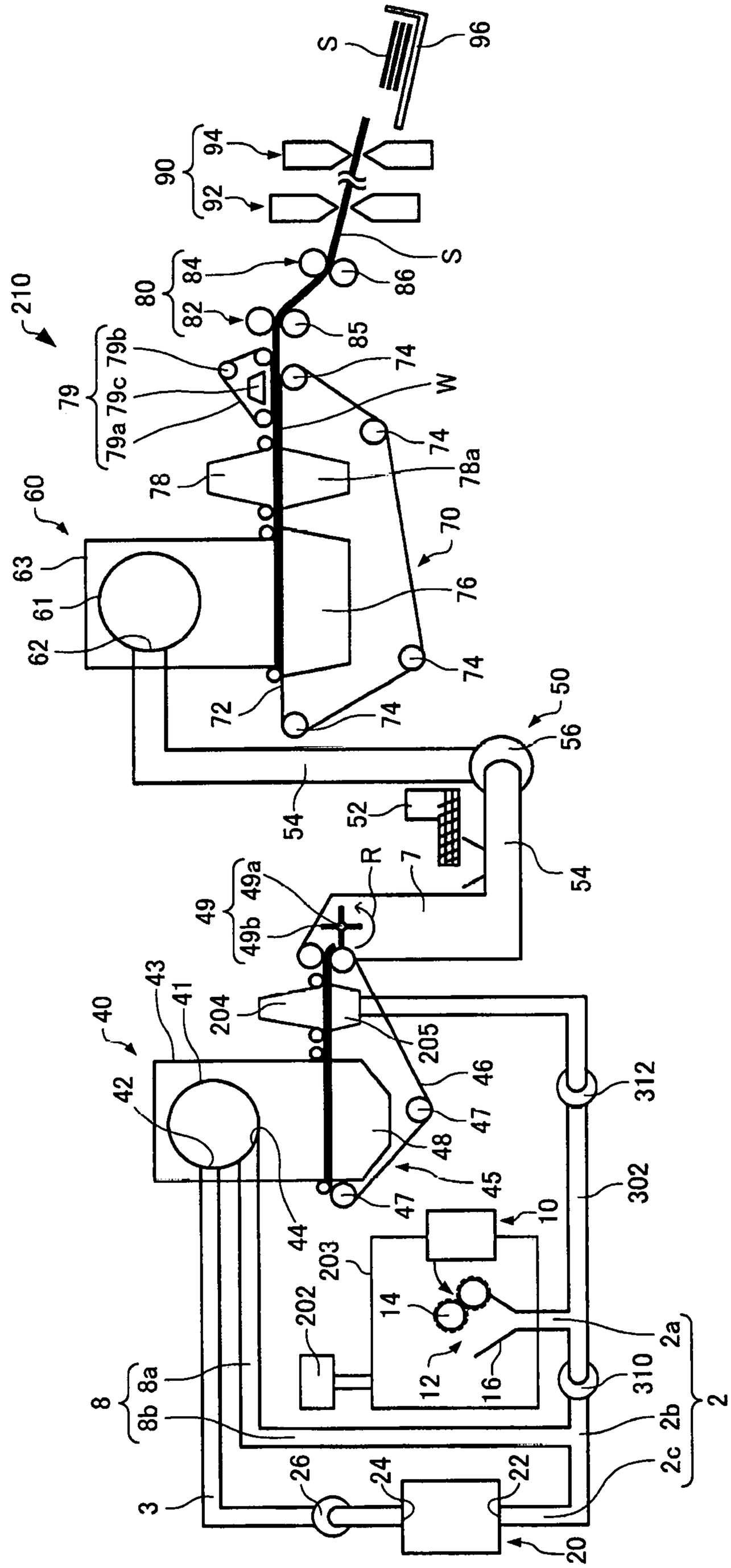
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FIG. 7

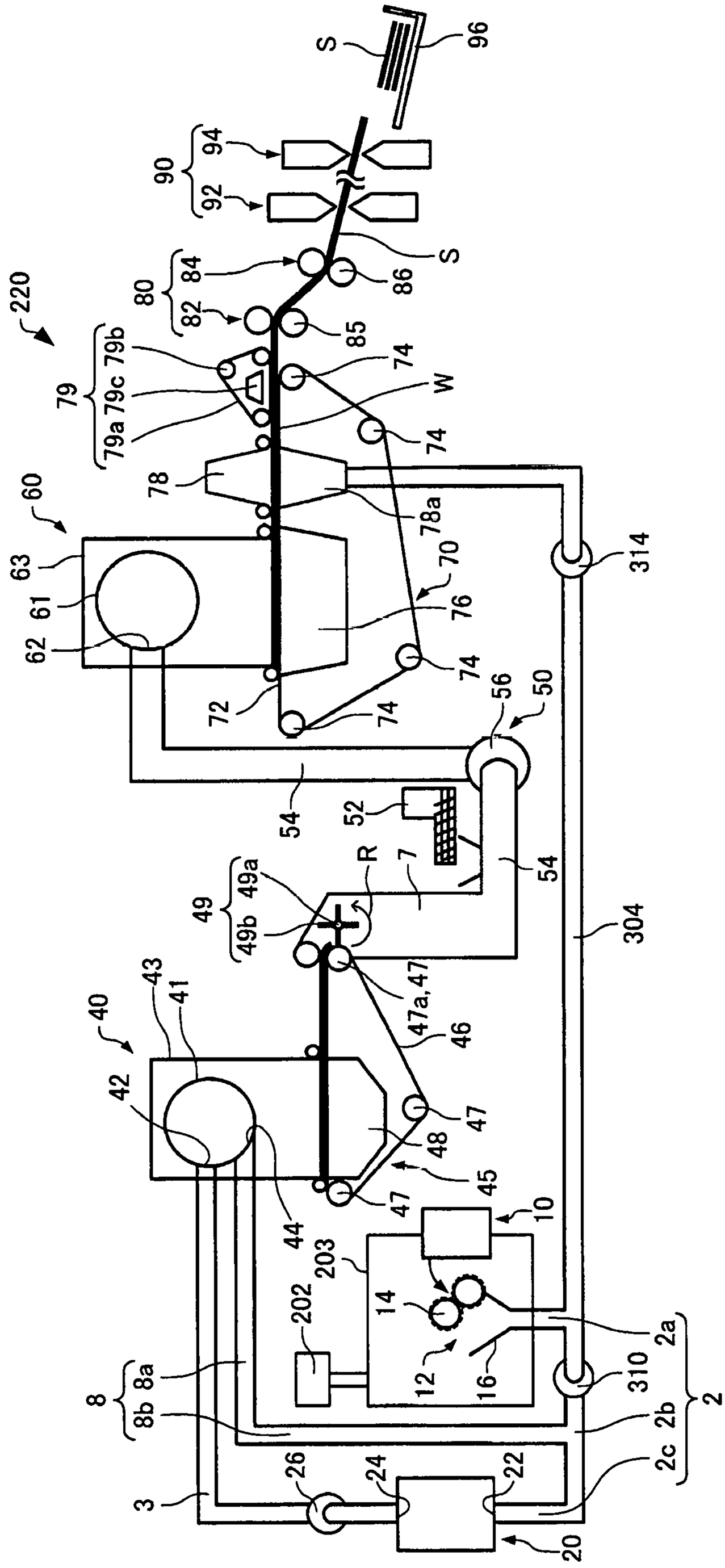
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FIG. 8

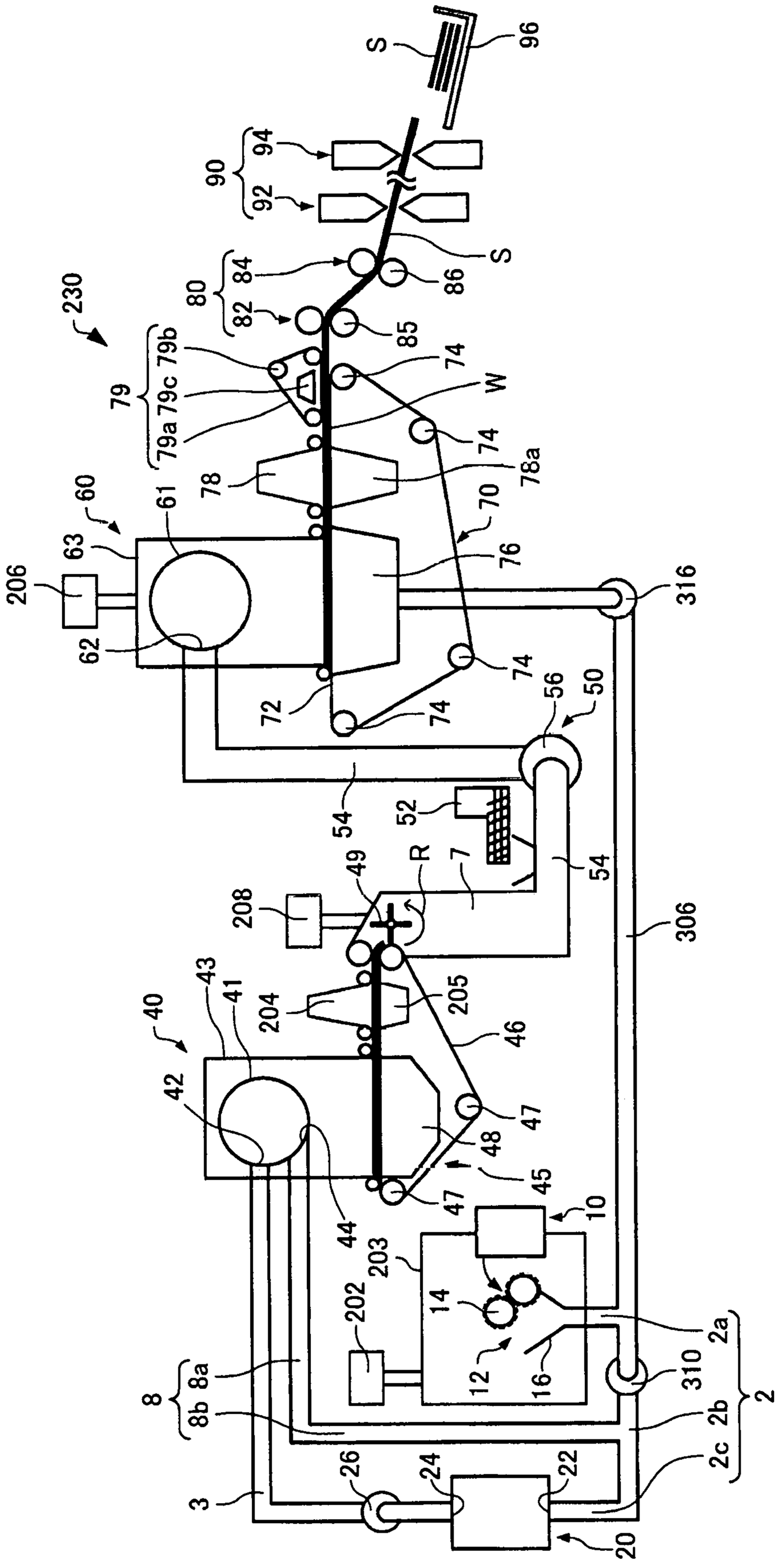
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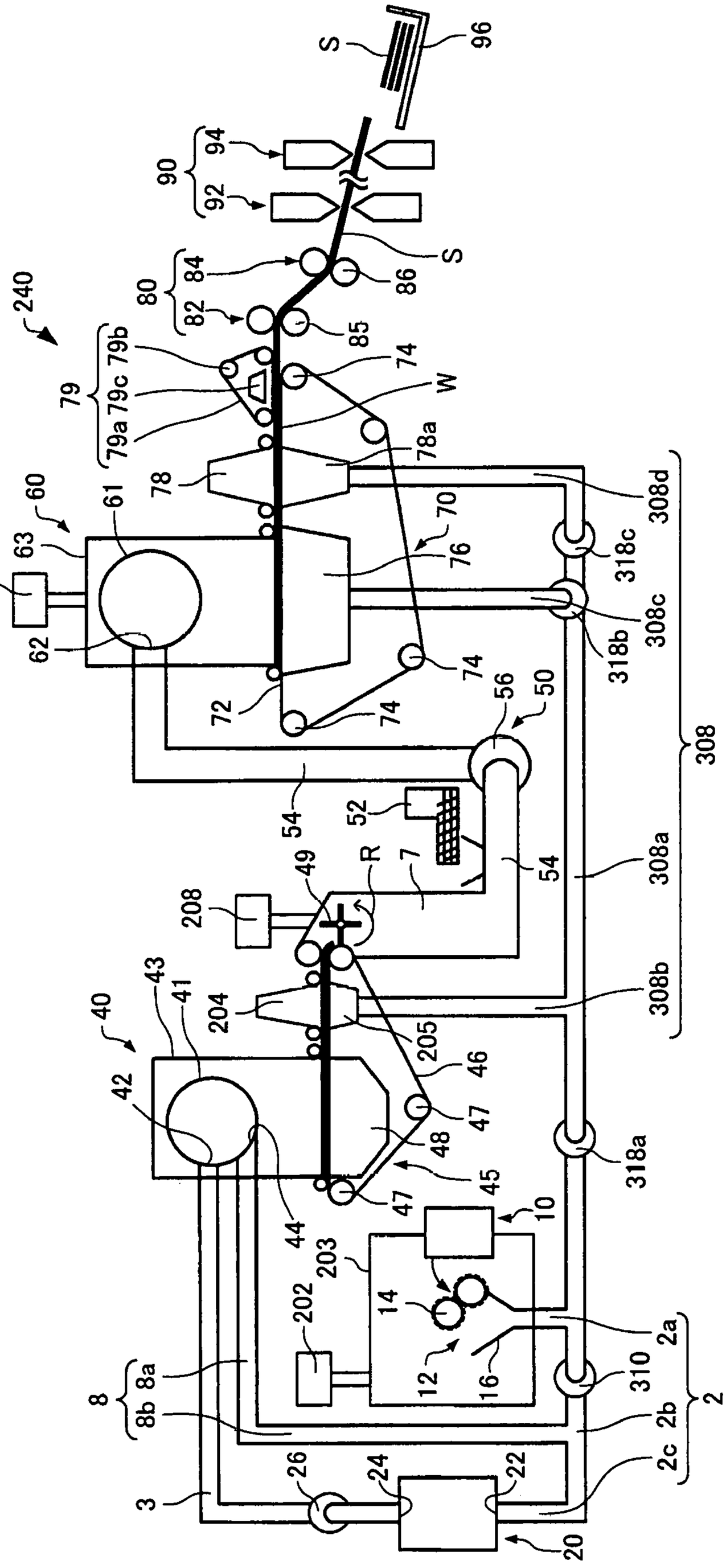
FIG. 9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SHEET MANUFACTURING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a U.S. National stage application of International Patent Application No. PCT/JP2017/002331, filed on Jan. 24, 2017, which claims priority under 35 U.S.C. § 119(a) to Japanese Patent Application No. 2016-029094, filed in Japan on Feb. 18, 2016. The entire disclosure of Japanese Patent Application No. 2016-029094 is hereby incorporated herein by reference.

TECHNICAL FIELD

The present invention relates to a sheet manufacturing apparatus.

BACKGROUND ART

In the related art, in a sheet manufacturing apparatus, a so-called wet type is adopted in which a raw material containing fibers is charged into water, the material is mainly defibrated by a mechanical action and is made into a sheet. Such a wet type sheet manufacturing apparatus requires a large amount of water and the apparatus becomes large. Furthermore, it takes time and effort to maintain maintenance of a water treatment facility, and the energy of a drying step increases. Therefore, in order to reduce the size and save energy, a dry type sheet manufacturing —apparatus that does not utilize water as much as possible has been proposed.

For example, in Japanese Unexamined Patent Application Publication No. 2015-66932, in a dry type sheet manufacturing apparatus, it is described that a residue that has not passed through a first opening of a sorting portion is transported to a hopper (hopper into which a strip cut by a coarse crushing blade is introduced) via a transport portion as a return flow passage and returned to a defibrating portion again.

The residue that did not pass through the first opening of the sorting portion is heated and dried by defibrating treatment. Therefore, when the residue is transported to the hopper (shooter) as in the sheet manufacturing apparatus described in Japanese Unexamined Patent Application Publication No. 2015-66932, the shooter dried and a strip (coarse crushed pieces) cut by a coarse crushing blade adhered to the shooter due to electrostatic force in some cases. As a result, the amount of defibrated materials flowing through the sheet manufacturing apparatus was unstable, and the thickness of the sheet to be manufactured might vary.

SUMMARY

An object of some aspects of the present invention is to provide a sheet manufacturing apparatus capable of suppressing adhesion of coarse crushed pieces to a shooter.

The present invention has been made to solve at least a portion of the above-described problems, and can be realized as the following aspects or application examples.

According to an aspect of the present invention, there is provided a sheet manufacturing apparatus including

a coarse crushing portion that crushes a raw material containing a fiber into coarse crushed pieces,

a defibrating portion that defibrates the coarse crushed pieces into a defibrated material,

a sieve portion that includes a plurality of openings,

a sheet forming portion that presses and heats the defibrated material passing through the opening of the sieve portion to form a sheet, and

a transport passage that transports the defibrated material, which has not passed through the opening of the sieve portion, between the coarse crushing portion and the defibrating portion.

In such a sheet manufacturing apparatus, it is possible to return the defibrated material dried and heated by the defibrating treatment to the pipe (pipe connecting the coarse crushing portion and the defibrating portion) on the downstream side of the coarse crushing portion without returning the defibrated material to the shooter of the coarse crushing portion. Therefore, in such a sheet manufacturing apparatus, it is possible to suppress the adhesion of the coarse crushed pieces cut by the coarse crushing blade of the coarse crushing portion to the shooter.

The sheet manufacturing apparatus according to the present invention may include

a humidifying portion that supplies humidified gas to the coarse crushing portion.

In such a sheet manufacturing apparatus, the coarse crushed pieces cut by the coarse crushing portion can be prevented from drying out. As a result, in such a sheet manufacturing apparatus, it is possible to more reliably suppress the adhesion of the coarse crushed pieces to the shooter due to the electrostatic force.

The sheet manufacturing apparatus according to the present invention may include

a humidifying portion that humidifies the defibrated material passing through the opening of the sieve portion, and

a supply passage that supplies gas humidified by the humidifying portion between the coarse crushing portion and the defibrating portion.

In such a sheet manufacturing apparatus, the gas humidified by the humidifying portion can humidify the inside of the pipe (pipe connecting the coarse crushing portion and the defibrating portion). As a result, in such a sheet manufacturing apparatus, it is possible to suppress the coarse crushed pieces passing through the pipe and the defibrated material from drying and adhering to the inner wall of the pipe due to the electrostatic force. Furthermore, in such a sheet manufacturing apparatus, the humidified gas can be recycled, and cost reduction can be achieved.

The sheet manufacturing apparatus according to the present invention may include

an accumulation portion that accumulates the defibrated material passing through the opening of the sieve portion,

a humidifying portion that humidifies an accumulated material accumulated by the accumulation portion, and

a supply passage that supplies gas humidified by the humidifying portion between the coarse crushing portion and the defibrating portion.

In such a sheet manufacturing apparatus, the gas humidified by the humidifying portion can humidify the inside of the pipe (pipe connecting the coarse crushing portion and the defibrating portion). As a result, in such a sheet manufacturing apparatus, it is possible to suppress the coarse crushed pieces passing through the pipe and the defibrated material from drying and adhering to the inner wall of the pipe due to the electrostatic force.

Furthermore, in such a sheet manufacturing apparatus, the humidified gas can be recycled, and cost reduction can be achieved.

According to another aspect of the present invention, there is provided a sheet manufacturing apparatus including

a coarse crushing portion that crushes a raw material containing a fiber into coarse crushed pieces,

a defibrating portion that defibrates the coarse crushed pieces into a defibrated material,

a sorting portion that sorts the defibrated material into a first sorted material and a second sorted material,

an accumulation portion that includes a sieve portion and a covering portion covering at least a portion of the sieve portion, and accumulates the first sorted material sorted by the sorting portion,

a sheet forming portion that presses and heats an accumulated material accumulated by the accumulation portion to form a sheet,

a first transport passage that transports the second sorted material sorted by the sorting portion between the coarse crushing portion and the defibrating portion,

a first humidifying portion that humidifies an inside of the covering portion of the accumulation portion, and

a supply passage that supplies gas humidified by the first humidifying portion between the coarse crushing portion and the defibrating portion.

In such a sheet manufacturing apparatus, the gas humidified by the first humidifying portion can humidify the inside of the pipe (pipe connecting the coarse crushing portion and the defibrating portion). As a result, in such a sheet manufacturing apparatus, it is possible to suppress the coarse crushed pieces passing through the pipe and the defibrated material from drying and adhering to the inner wall of the pipe due to the electrostatic force. Furthermore, in such a sheet manufacturing apparatus, the humidified gas can be recycled, and cost reduction can be achieved.

The sheet manufacturing apparatus according to the present invention may include

a second humidifying portion that humidifies the first sorted material sorted by the sorting portion, and

a third humidifying portion that humidifies the accumulated material accumulated by the accumulation portion,

in which the supply passage is a supply passage which supplies the gas humidified by the first humidifying portion, gas humidified by the second humidifying portion, and gas humidified by the third humidifying portion between the coarse crushing portion and the defibrating portion.

In such a sheet manufacturing apparatus, the gas humidified by the first humidifying portion, the second humidifying portion, and the third humidifying portion can humidify the inside of the pipe (pipe connecting the coarse crushing portion and the defibrating portion). As a result, in such a sheet manufacturing apparatus, it is possible to more reliably suppress the coarse crushed pieces passing through the pipe and the defibrated material from drying and adhering to the inner wall of the pipe due to the electrostatic force.

The sheet manufacturing apparatus according to the present invention may include

a second transport passage that transports the first sorted material sorted by the sorting portion to the accumulation portion, and

a fourth humidifying portion that introduces humidified gas into the second transport passage.

In such a sheet manufacturing apparatus, it is possible to humidify the second transport passage by the gas humidified by the fourth humidifying portion. As a result, in such a sheet manufacturing apparatus, it is possible to suppress the adhere of the defibrated material by the electrostatic force to the member (for example, rotating object) located in the second transport passage.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a view schematically illustrating a sheet manufacturing apparatus according to a first embodiment.

FIG. **2** is a view schematically illustrating the sheet manufacturing apparatus according to the first embodiment.

FIG. **3** is a view schematically illustrating the sheet manufacturing apparatus according to the first embodiment.

FIG. **4** is a view schematically illustrating a sheet manufacturing apparatus according to a modified example of the first embodiment.

FIG. **5** is a view schematically illustrating a sheet manufacturing apparatus according to a second embodiment.

FIG. **6** is a view schematically illustrating a sheet manufacturing apparatus according to a first modified example of the second embodiment.

FIG. **7** is a view schematically illustrating a sheet manufacturing apparatus according to a second modified example of the second embodiment.

FIG. **8** is a view schematically illustrating a sheet manufacturing apparatus according to a third modified example of the second embodiment.

FIG. **9** is a view schematically illustrating a sheet manufacturing apparatus according to a fourth modified example of the second embodiment.

DESCRIPTION OF EMBODIMENTS

Hereinafter, preferred embodiments of the present invention will be described in detail below with reference to the drawings. The embodiments described below do not unduly limit the contents of the present invention described in the aspects. In addition, not all of the configurations described below are necessarily essential components of the present invention.

1. First Embodiment

1.1. Sheet Manufacturing Apparatus

1.1.1. Configuration

First, a sheet manufacturing apparatus according to the first embodiment will be described with reference to the drawings. FIG. **1** is a view schematically illustrating a sheet manufacturing apparatus **100** according to the first embodiment.

As illustrated in FIG. **1**, the sheet manufacturing apparatus **100** is provided with a supply portion **10**, a coarse crushing portion **12**, a defibrating portion **20**, a sorting portion **40**, a first web forming portion **45**, a rotating object **49**, a mixing portion **50**, an accumulation portion **60**, a second web forming portion **70**, a sheet forming portion **80**, and a cutting portion **90**.

The supply portion **10** supplies the raw material to the coarse crushing portion **12**. The supply portion **10** is, for example, an automatic input portion for continuously inputting the raw material into the coarse crushing portion **12**. The raw material supplied by the supply portion **10** contains fibers such as waste paper and pulp sheet, for example.

The coarse crushing portion **12** cuts (coarsely crushes) the raw material supplied by the supply portion **10** in the air such as atmosphere (in air) to form coarse crushed pieces. The shape and size of the coarse crushed piece is, for example, a strip of several cm square. The coarse crushing portion **12** has, for example, a coarse crushing blade **14** and a shooter (hopper) **16**. The coarse crushing portion **12** is able to cut the input raw material by the coarse crushing blade **14**. For example, a shredder is used as the coarse crushing portion **12**. The raw material cut by the coarse crushing blade **14** is transferred (transported) to the defibrating portion **20** via a pipe **2** after being received by the shooter **16**.

The defibrating portion **20** defibrates the raw material (coarse crushed piece) cut by the coarse crushing portion **12** into a defibrated material. Here, "to defibrate" means to unravel the raw material (material to be defibrated) formed by binding a plurality of fibers to each fiber one by one. The defibrating portion **20** also has a function of separating substances such as resin material, ink, toner, bleed inhibitor and the like attached to the raw material from the fiber.

Material which passed through the defibrating portion **20** is referred to as "defibrated material". The "defibrated material" may contain resin (resin for bonding a plurality of fibers) material separated from fibers when unraveling fibers, coloring agents such as ink and toner, or additives such as bleed inhibitor and paper strength enhancer in addition to unraveling defibrated fibers. The shape of unraveled defibrated material is a string or ribbon shape. The unraveled defibrated material may exist in a state not intertwined with other unraveled fiber (independent state), or may exist in a state of being intertwined with other unraveled defibrated material to form a lump (state of forming so-called "lump").

The defibrating portion **20** performs defibration with a dry method. Herein, performing treatment such as defibration in the air such as atmosphere (in air) rather than in a liquid is referred to as the dry method. As the defibrating portion **20**, an impeller mill is used in this embodiment. The defibrating portion **20** has a function of generating the air flow that sucks the raw material and discharges the defibrated material. As a result, the defibrating portion **20** can suck the raw material together with the air flow from an introduction port **22** by the air flow generated by itself, and can perform defibration treatment to transport the defibrated material to a discharge port **24**. The defibrated material that has passed through the defibrating portion **20** is transferred to the sorting portion **40** via a pipe **3**. As the air flow for transporting the defibrated material from the defibrating portion **20** to the sorting portion **40**, the air flow generated by the defibrating portion **20** may be used, or a blower **26** as an air flow generation device may be provided as illustrated in FIG. **1**, and the air flow thereof may be used.

In the sorting portion **40**, the defibrated material defibrated by the defibrating portion **20** is introduced from an introduction port **42** and sorted according to the length of the fiber. The sorting portion **40** has a drum portion **41** (sieve portion) and a housing portion (covering portion) **43** for housing the drum portion **41**. As the drum portion **41**, for example, a sieve is used. The drum portion **41** has a mesh (filter, screen) and can sort a fiber or a material smaller than a size of mesh sieve (opening) (those passing through the mesh, first sorted material), and a fiber, un-defibrated piece, or a lump larger than the size of mesh sieve (those not passing through the mesh, second sorted material). That is, the sorting portion **40** can sort the defibrated material into a first sorted material and a second sorted material. For example, the first sorted material is transferred to the mixing portion **50** via a pipe **7**. The second sorted material is returned from a discharge port **44** to the defibrating portion **20** via a pipe **8**. Specifically, the drum portion **41** is a sieve of a cylinder rotationally driven by a motor. As the mesh of the drum portion **41**, for example, a wire mesh, an expanded metal obtained by stretching a metal plate with a notch, and a punching metal having a hole formed in a metal plate by a pressing machine or the like are used.

The first web forming portion **45** transports the first sorted material that has passed through the sorting portion **40** to the mixing portion **50**. The first web forming portion **45** includes a mesh belt **46**, a stretching roller **47**, and a suction portion (suction mechanism) **48**.

The suction portion **48** can suck the first sorted material dispersed in the air through an opening (mesh opening) of the sorting portion **40** onto the mesh belt **46**. The first sorted material is accumulated on the moving mesh belt **46** to form a web V. The basic configuration of the mesh belt **46**, the stretching roller **47**, and the suction portion **48** is the same as that of a mesh belt **72**, a stretching roller **74**, and a suction mechanism **76** of a second web forming portion **70** described later.

By passing through the sorting portion **40** and the first web forming portion **45**, a web V containing a large amount of air and in a soft and swelling state is formed. The web V accumulated on the mesh belt **46** is introduced into the pipe **7** and transported to the mixing portion **50**.

The rotating object **49** can cut (divide) the web V before the web V is transported to the mixing portion **50**. In the illustrated example, the rotating object **49** has a base portion **49***a* and a projection portion **49***b* projecting from the base portion **49***a*. The projection portion **49***b* has, for example, a plate shape. In the illustrated example, four projection portions **49***b* are provided, and four projection portions **49***b* are provided at equal intervals. By rotation of the base portion **49***a* in a direction R, the projection portion **49***b* can rotate about the base portion **49***a*. By cutting the web V with the rotating object **49**, it is possible to reduce fluctuation in the amount of defibrated material per unit time supplied to the accumulation portion **60**, for example.

The rotating object **49** is provided in the vicinity of the first web forming portion **45**. In the illustrated example, the rotating object **49** is provided in the vicinity of a stretching roller **47***a* (next to stretching roller **47***a*) located on the downstream side in the passage of the web V. The rotating object **49** is provided at a position where the projection portion **49***b* can be in contact with the web V and is not in contact with the mesh belt **46** on which the web V is accumulated. As a result, it is possible to prevent the mesh belt **46** from being worn (damaged) by the projection portion **49***b*. The shortest distance between the projection portion **49***b* and the mesh belt **46** is, for example, 0.05 mm or more and 0.5 mm or less. If the shortest distance between the projection portion **49***b* and the mesh belt **46** is within the above range, the rotating object **49** can cut the web V without damaging the mesh belt **46**.

The mixing portion **50** mixes the first sorted material (first sorted material transported by first web forming portion **45**) that has passed through the sorting portion **40** and the additive including a resin. The mixing portion **50** has an additive supply portion **52** for supplying the additive, a pipe **54** for transporting the first sorted material and the additive, and a blower **56**. In the illustrated example, the additive is supplied to the pipe **54** from the additive supply portion **52** via a shooter **9**. The pipe **54** is continuous with the pipe **7**.

In the mixing portion **50**, air flow is generated by the blower **56**, and the first sorted material and additives can be transported while being mixed in the pipe **54**. The mechanism for mixing the first sorted material and the additive is not particularly limited, and may be a mechanism that stirs with a blade rotating at high speed, or a mechanism that uses rotation of a container like a V type mixer.

As the additive supply portion **52**, a screw feeder as illustrated in FIG. **1**, a disk feeder not illustrated or the like is used. The additive supplied from the additive supply portion **52** contains a resin for binding a plurality of fibers. When the resin is supplied, the plurality of fibers are not

bound. When passing through the sheet forming portion **80**, the resin melts and binds the plurality of fibers.

The resin supplied from the additive supply portion **52** is a thermoplastic resin or a thermosetting resin, and examples thereof include AS resin, ABS resin, polypropylene, polyethylene, polyvinyl chloride, polystyrene, acrylic resin, polyester resin, polyethylene terephthalate, polyphenylene ether, polybutylene terephthalate, nylon, polyamide, polycarbonate, polyacetal, polyphenylene sulfide, polyether ether ketone, and the like. These resins may be used singly or as a mixture thereof. The additive supplied from the additive supply portion **52** may be in a fibrous form or powder form.

The additives supplied from the additive supply portion **52** may contain a coloring agent for coloring the fibers, an aggregation inhibitor for suppressing aggregation of the fibers or aggregation of the fibers, and a flame retardant for causing fibers less flammable, in addition to the resin binding the fibers, depending on the type of the sheet to be manufactured. The mixture (mixture of first sorted material and additive) that has passed through the mixing portion **50** is transferred to the accumulation portion **60** via the pipe **54**.

The accumulation portion **60** introduces the mixture that has passed through the mixing portion **50** from an introduction port **62**, unravels the intertwined defibrated material (fibers), and descends while dispersing in the air. Furthermore, in a case where the resin of the additive supplied from the additive supply portion **52** has a fibrous form, the accumulation portion **60** unravels the intertwined resin. As a result, the accumulation portion **60** can accumulate the mixture with good uniformity in the second web forming portion **70**.

The accumulation portion **60** has a drum portion (sieve portion) **61** and a housing portion (covering portion) **63** for accommodating the drum portion **61**. As the drum portion **61**, a rotating cylindrical sieve is used. The drum portion **61** has a mesh and causes fibers or particles (fibers or material passing through mesh) smaller than the size of mesh sieve (opening) and contained in the mixture passed through the mixing portion **50** to descend. The configuration of the drum portion **61** is, for example, the same as that of the drum portion **41**.

The "sieve" of the drum portion **61** may not have the function of sorting out a specific object. That is, the "sieve" used as the drum portion **61** means that the sieve has a mesh, and the drum portion **61** may descend all of the mixture introduced to the drum portion **61**.

The second web forming portion **70** accumulates a passing material that has passed through the accumulation portion **60** to form a web W. The second web forming portion **70** has, for example, a mesh belt **72**, a stretching roller **74**, and a suction mechanism **76**.

While moving, the mesh belt **72** accumulates the passing material passing through the opening (opening of mesh) of the accumulation portion **60**. The mesh belt **72** is stretched by the stretching roller **74**, and is configured so as to allow air to pass therethrough with difficulty in passing the passing material. The mesh belt **72** moves as the stretching roller **74** rotates on its own axis. While the mesh belt **72** continuously moves, the passing material passing through the accumulation portion **60** continuously accumulates, so that the web W is formed on the mesh belt **72**. The mesh belt **72** is formed of, for example, metal, resin, cloth, or nonwoven fabric.

The suction mechanism **76** is provided below the mesh belt **72** (on a side opposite to accumulation portion **60** side). The suction mechanism **76** can generate an air flow directed downward (air flow directed from the accumulation portion **60** to the mesh belt **72**). By the suction mechanism **76**, the mixture dispersed in the air by the accumulation portion **60** can be sucked onto the mesh belt **72**. As a result, the discharge rate from the accumulation portion **60** can be increased. Furthermore, the suction mechanism **76** can form a down flow in the falling passage of the mixture, and it is possible to prevent from being intertwined with the defibrated material and the additive during the falling.

As described above, by passing through the accumulation portion **60** and the second web forming portion **70** (web forming step), a web W containing a large amount of air and in a soft and swelling state is formed. The web W accumulated on the mesh belt **72** is transported to the sheet forming portion **80**.

In the illustrated example, a humidity conditioning portion (humidifying portion for humidifying web W) **78** for conditioning the web W is provided. A humidifying portion **78** can adjust the amount ratio between the web W and water by adding water or vapor to the web W. In the illustrated example, the humidifying portion **78** is provided above the mesh belt **72** (on accumulation portion **60** side). A suction mechanism **78***a* is provided below the mesh belt **72** (side opposite to humidifying portion **78** side). The suction mechanism **78***a* can generate an air flow directed downward (directed to mesh belt **72** from humidifying portion **78**). As a result, it possible to humidify the web W uniformly in the thickness direction.

In addition, in the illustrated example, a transport portion **79** for transporting the web W on the mesh belt **72** to the sheet forming portion **80** is provided. The transport portion **79** has, for example, a mesh belt **79***a*, a stretching roller **79***b*, and a suction mechanism **79***c*. The suction mechanism **79***c* generates an air flow to suck the web W and causes the mesh belt **79***a* to adsorb the web W. The mesh belt **79***a* moves due to the rotation of the stretching roller **79***b*, and transports the web W to the sheet forming portion **80**. The movement speed of the mesh belt **72** and the movement speed of the mesh belt **79***a* are the same as each other, for example.

The sheet forming portion **80** presses and heats the web W accumulated on the mesh belt **72** (accumulated material accumulated by accumulation portion **60**) to form a sheet S. In the sheet forming portion **80**, a plurality of fibers in the mixture can be bound to each other via the additive (resin) by applying heat to the mixture of the defibrated material and additive mixed in the web W.

The sheet forming portion **80** is provided with a pressing portion **82** that presses the web W and a heating portion **84** that heats the web W pressed by the pressing portion **82**. The pressing portion **82** is configured to include a pair of calendar rollers **85**, and applies pressure to the web W. As the web W is pressed, the thickness decreases and the density of the web W increases. As the heating portion **84**, for example, a heating roller, a hot press molding machine, a hot plate, a hot air blower, an infrared heater, and a flash fixing device are used. In the illustrated example, the heating portion **84** is provided with a pair of heating rollers **86**. By configuring the heating portion **84** as the pair of heating rollers **86**, the sheet S can be formed while continuously transporting the web W, as compared with a case where the heating portion **84** is configured as a plate-like pressing device (flat plate pressing device). Here, the calendar rollers **85** (pressing portion **82**) can apply a pressure higher than the pressure applied to the web W by the heating rollers **86** (heating portion **84**) to the web W. The number of the calendar rollers **85** and the pair of heating rollers **86** is not particularly limited.

The cutting portion **90** cuts the sheet S formed by the sheet forming portion **80**. In the illustrated example, the cutting portion **90** has a first cutting portion **92** for cutting the sheet S in a direction intersecting with the transport direction of the sheet S and a second cutting portion **94** for cutting the sheet S in a direction parallel to the transport direction. For example, the second cutting portion **94** cuts the sheet S that has passed through the first cutting portion **92**.

As described above, a single sheet S of a predetermined size is formed. The cut single sheet S is discharged to a discharge portion **96**.

In the sheet manufacturing apparatus **100**, the defibrated material that has passed through the defibrating portion **20** may be transferred to a classifying portion (not illustrated) via the pipe **3**. A classified material in the classifying portion may be transported to the sorting portion **40**. The classifying portion classifies the defibrated material that has passed through the defibrating portion **20**. Specifically, the classifying portion separates and removes relatively small material or material with low density (such as resin material, coloring agent, and additive) among the defibrated materials. As a result, it is possible to increase the proportion occupied by fibers which are relatively large material or material with high density among the defibrated materials. As the classifying portion, for example, cyclone, elbow jet, eddy classifier are used.

1.1.2. Pipe

The sheet manufacturing apparatus **100** has the pipes **2** and **8** as described above. Hereinafter, the pipes **2** and **8** will be described in detail.

As illustrated in FIG. **1**, the pipe **2** connects the coarse crushing portion **12** with the defibrating portion **20**. In the illustrated example, the pipe **2** connects the shooter **16** of the coarse crushing portion **12** with the defibrating portion **20**. For example, the inner diameter of the pipe **2** is 50 mm or more and 60 mm or less. The pipe **2** forms a transport passage for transporting the raw material (coarse crushed piece) cut by the coarse crushing blade **14** to the defibrating portion **20**.

The shooter **16** has, for example, a tapered shape in which the width gradually decreases in a direction where the coarse crushed piece flows (in a traveling direction). Therefore, the shooter **16** can receive many coarse crushed pieces.

The pipe **2** has, for example, a first portion **2***a*, a second portion **2***b*, and a third portion **2***c*. The first portion **2***a* and the third portion **2***c*, for example, extend in a vertical direction. The second portion **2***b*, for example, extends in a horizontal direction. The first portion **2***a* connects the coarse crushing portion **12** with the second portion **2***b*. The second portion **2***b* connects the first portion **2***a* with the third portion **2***c*. The third portion **2***c* connects the second portion **2***b* and the defibrating portion **20**.

The pipe **8** connects the sorting portion **40** with the pipe **2**. In the illustrated example, the pipe **8** connects the sieve portion **41** (sieve portion having a plurality of openings) of the sorting portion **40** with the second portion **2***b* of the pipe **2**. For example, the inner diameter of the pipe **8** is 90 mm or more and 120 mm or less. The pipe **8** forms the transport passage (first transport passage) for transporting the defibrated material (second sorted material) which did not pass through the opening of the sieve portion **41** between the coarse crushing portion **12** and the defibrating portion **20** (into the pipe **2**). The second sorted material is dried and heated as it passes through the defibrating portion **20** once (since defibrating treatment is performed). The second sorted material reaches the defibrating portion **20** again through the pipe **8** and the pipe **2** (portions **2***b* and **2***c*). The sheet forming portion **80** pressurizes and heats the defibrated material (first sorted material) that has passed through the opening of the sieve portion **41** to form a sheet S.

The pipe **8** has, for example, a fourth portion **8***a* and a fifth portion **8***b*. The fourth portion **8***a* extends in the horizontal direction, for example. The fifth portion **8***b* extends in the vertical direction, for example. The fourth portion **8***a* connects the sorting portion **40** with the fifth portion **8***b*. The fifth portion **8***b* connects the fourth portion **8***a* with the second portion **2***b* of the pipe **2**. The fifth portion **8***b* can transport the second sorted material into the pipe **2**, for example, by gravity. In the illustrated example, the second portion **2***b* of the pipe **2** is orthogonal to the fifth portion **8***b* of the pipe **8**.

1.1.3. Configuration in a Vicinity of Rotating Object

FIG. **2** is an enlarged view of the vicinity of the rotating object **49** in FIG. **1**. As illustrated in FIG. **2**, the sheet manufacturing apparatus **100** has a separation portion **102**, a detection portion **106**, and a control portion **108**. For the sake of convenience, illustration of the separation portion **102**, the detection portion **106**, the control portion **108**, and a subdivided object **11** (web V cut by rotating object **49**) is omitted in FIG. **1**.

The separation portion **102** is a member for separating the web V accumulated on the mesh belt **46** from the mesh belt **46**. The separation portion **102** has a fixing plate **104**. In the illustrated example, the separation portion **102** is constituted by the fixing plate **104**. The fixing plate **104** is provided in the vicinity of the rotating object **49**. In the illustrated example, the web forming portion **45** has three stretching rollers **47** on which the mesh belt **46** is stretched, and the fixing plate **104** faces the stretching roller **47***a* located on the side closest to the rotating object **49** among the three stretching rollers via the mesh belt **46**. The fixing plate **104** is in contact with the mesh belt **46** in a state where the mesh belt **46** is movable. The fixing plate **104** does not move with the movement of the mesh belt **46** and is fixed.

The detection portion **106** detects the thickness of the web V accumulated on the mesh belt **46**. For example, the detection portion **106** receives reflected light on a front surface of the web V and the reflected light on a rear surface, and an optical sensor that detects the thickness of the web V based on the time difference between the reflected light on the front surface and the reflected light on the rear surface. The detection portion **106**, for example, faces the mesh belt **46**.

The control portion **108** may control a movement speed of the mesh belt **46** by outputting a first signal to a first drive portion (not illustrated) that drives the stretching roller **47** based on the thickness of the web V detected by the detection portion **106**. For example, in a case where the thickness of the web V detected by the detection portion **106** is greater than a predetermined value, the control portion **108** controls so as to decrease the movement speed of the mesh belt **46**. As a result, the amount of the defibrated material per unit time supplied to the mixing portion **50** can be prevented from increasing. In addition, for example, in a case where the thickness of the web V detected by the detection portion **106** is smaller than the predetermined value, the control portion **108** controls so as to increase the movement speed of the mesh belt **46**. As a result, the amount of the defibrated material per unit time supplied to the mixing portion **50** can be prevented from decreasing. That is, the control portion **108** controls the movement speed of the

mesh belt **46** so that the variation of the amount (mass) of the defibrated material per unit time supplied to the mixing portion **50** is small.

The control portion **108** may control a rotation speed of the rotating object **49** by outputting a second signal to a second drive portion (not illustrated) for driving the rotating object **49** according to the movement speed of the mesh belt **46**. For example, data on the movement speed of the mesh belt **46** and the rotation speed of the rotating object **49** are stored in advance in a storage portion (not illustrated), and the control portion **108** may control the rotation speed of the rotating object **49** based on the data and the first signal. For example, in a case where the movement speed of the mesh belt **46** is controlled so as to be decreased by the first signal, the control portion **108** controls so as to decrease the rotation speed of the rotating object **49**. As a result, the volume of the subdivided object **11** supplied to the mixing portion **50** can be prevented from decreasing. In addition, for example, in a case where the movement speed of the mesh belt **46** is controlled so as to be increased by the first signal, the control portion **108** controls so as to increase the rotation speed of the rotating object **49**. As a result, the volume of the subdivided object **11** supplied to the mixing portion **50** can be prevented from increasing. That is, the control portion **108** controls the rotation speed of the rotating object **49** so that the variation of the volume of the subdivided object **11** supplied to the mixing portion **50** is small.

The control portion **108** may control the rotation speed of the rotating object **49** by outputting a third signal to a second drive portion (not illustrated) that drives the rotating object **49** based on the thickness of the web V detected by the detection portion **106**. For example, in a case where the thickness of the web V detected by the detection portion **106** is greater than the predetermined value, the control portion **108** controls so as to increase the rotation speed of the rotating object **49**. As a result, the volume of the subdivided object **11** supplied to the mixing portion **50** can be prevented from increasing. In addition, for example, in a case where the thickness of the web V detected by the detection portion **106** is smaller than the predetermined value, the control portion **108** controls so as to decrease the rotation speed of the rotating object **49**. As a result, the volume of the subdivided object **11** supplied to the mixing portion **50** can be prevented from decreasing.

In the sheet manufacturing apparatus **100**, as illustrated in FIG. **3**, the separation portion **102** may have an air flow generation portion **105**. In the illustrated example, the separation portion **102** is constituted by the air flow generation portion **105**. The air flow generation portion **105** generates an air flow A in a direction where the web V separates from the mesh belt **46**. The air flow generation portion **105** generates the air flow A in the vicinity of the rotating object **49**. Here, the fact that "air flow generation portion **105** generates the air flow A in the vicinity of the rotating object **49**" means that the air flow A generated in the air flow generation portion **105** reaches the rotating object **49**. For the sake of convenience, illustration of the control portion **108** is omitted in FIG. **3**.

The sheet manufacturing apparatus **100** has, for example, the following features.

The sheet manufacturing apparatus **100** has the pipe **8** forming a transport passage for transporting the defibrated material (second sorted material) that has not passed through the opening of the sieve portion **41** between the coarse crushing portion **12** and the defibrating portion **20**. Therefore, in the sheet manufacturing apparatus **100**, it is possible to return the second sorted material dried and heated by the defibration treatment into the pipe **2** on the downstream side of the coarse crushing portion **12** without returning the second sorted material to the shooter **16** of the coarse crushing portion **12**. Therefore, in the sheet manufacturing apparatus **100**, it is possible to suppress the adhesion of the coarse crushed piece to the shooter **16**. Therefore, in the sheet manufacturing apparatus **100**, it is possible to prevent the amount of defibrated material flowing through the sheet manufacturing apparatus **100** from being unstable, and to suppress variations in the thickness of the sheet S.

For example, when the second sorted material is returned to the shooter **16**, the shooter **16** is warmed by the second sorted material, drying of the defibrated material progresses, and the coarse crushed piece (charged coarse crushed piece) may adhere to the shooter **16** due to the electrostatic force. Since the shooter **16** has a tapered shape, for example, there is a portion where the wind velocity of the air flow by the blower **26** becomes small in the shooter **16**, and when the dried second sorted material is charged therein, the coarse crushed piece adheres due to the electrostatic force. In the sheet manufacturing apparatus **100**, it is possible to avoid the above problem.

For example, in a case of returning the second sorted material to the shooter **16**, the temperature of the shooter **16** was 50° C. and the relative humidity in the vicinity of the shooter **16** was 12%, whereas in the sheet manufacturing apparatus **100** for returning the second sorted material into the pipe **2**, it was possible to set the temperature of the shooter **16** at 30° C. and the relative humidity in the vicinity of the shooter **16** to 40%. For example, in a case where the relative humidity in the vicinity of the shooter **16** is 30% or less, adhesion of the coarse crushed piece due to electrostatic force occurs.

Although not illustrated, the sheet manufacturing apparatus **100** may have a pipe for returning the defibrated material that did not passed through the opening of the sieve portion **61** of the accumulation portion **60** into the pipe **2**. As a result, the sheet manufacturing apparatus **100** can prevent the coarse crushed piece from drying and adhering to the shooter **16** due to the defibrated material that did not pass through the opening of the sieve portion **61**.

In addition, although not illustrated, in a case where the passage of the pipe **8** is long, or in a case where a joint portion between the pipe **2** and the pipe **8** is in the horizontal direction with respect to the discharge port **44** or above the discharge port **44**, it is preferable to provide a blower in the pipe **2** and the pipe **8** for transporting the second sorted material into the pipe **2**.

1.2. Modified Example of Sheet Manufacturing Apparatus

Next, a sheet manufacturing apparatus according to a modified example of the first embodiment will be described with reference to the drawings. FIG. **4** is a view schematically illustrating a sheet manufacturing apparatus **110** according to the modified example of the first embodiment. Hereinafter, in the sheet manufacturing apparatus **110** according to the modified example of the first embodiment, members having the same functions as those of the above-described sheet manufacturing apparatus **100** are denoted by the same reference numerals, and a detailed description thereof will be omitted.

In the above-described sheet manufacturing apparatus **100**, as illustrated in FIG. **1**, the pipe **2** is configured to include linearly extending portions **2***a*, **2***b*, and **2***c*. On the other hand, in the sheet manufacturing apparatus **110**, as illustrated in FIG. **4**, the pipe **2** has a curved shape. An introduction port **2***d* is provided inside the curved pipe **2**.

The introduction port **2***d* is an opening for introducing the second sorted material transported by the pipe **8** into the pipe **2**.

Since the pipe **2** is curved, an air flow (air flow generated by the blower **26**, for example) a generated in the pipe **2** causes a velocity difference (wind velocity) due to centrifugal force. That is, in the air flow α passing through the pipe **2**, the velocity inside the pipe **2** (side with larger curvature) is smaller than the velocity outside the pipe **2** (side with smaller curvature). As described above, the air flow α has the velocity difference in a direction orthogonal to the direction of the air flow α. The introduction port **2***d* is provided on the side where the velocity of the air flow α is low (inside pipe **2**). The difference between the velocity of the air flow α inside the pipe **2** and the velocity of the air flow α outside the pipe **2** is, for example, 1 m/s or more and 10 m/s or less, and preferably approximately 5 m/s.

In the sheet manufacturing apparatus **110**, the air flow α has the velocity difference in a direction orthogonal to the direction of the air flow α in the pipe **2**, and the introduction port **2***d* is provided on the side where the velocity of air flow α is low. Therefore, in the sheet manufacturing apparatus **110**, a force acts on the side where the velocity of the air flow α is high (outside of the pipe **2**) from the side where the velocity of the air flow α is low (inside of the pipe **2**), and it is possible to suppress the blowback of the air flow α at the introduction port **2***d*. Therefore, in the sheet manufacturing apparatus **110**, it is possible to suppress retention of the coarse crushed piece due to the disturbance of the air flow α by the blowback of the air flow α. Furthermore, in the sheet manufacturing apparatus **110**, for example, it is possible to suppress the retention of the coarse crushed piece due to the lack of the air volume on the downstream side by the blowback of the air flow α. As a result, in the sheet manufacturing apparatus **110**, it is possible to stably transport the coarse crushed piece.

2. Second Embodiment

2.1. Sheet Manufacturing Apparatus

Next, a sheet manufacturing apparatus according to a second embodiment will be described with reference to the drawings. FIG. **5** is a view schematically illustrating a sheet manufacturing apparatus **200** according to the second embodiment. Hereinafter, in the sheet manufacturing apparatus **200** according to the second embodiment, members having the same functions as those of the above-described sheet manufacturing apparatus **100** are denoted by the same reference numerals, and a detailed description thereof will be omitted.

The sheet manufacturing apparatus **200** differs from the above-described sheet manufacturing apparatus **100** in that the sheet manufacturing apparatus **200** has a humidifying portion **202** as illustrated in FIG. **5**. The humidifying portion **202** supplies humidified gas to the coarse crushing portion **12**. In the illustrated example, a portion of the coarse crushing portion **12** and the supply portion **10** is stored in the storage portion **203**. The humidifying portion **202** can supply the humidified gas into the storage portion **203** and humidify the coarse crushing portion **12**. In the illustrated example, the first portion **2***a* of the pipe **2** extends from the inside of the storage portion **203** to the outside of the storage portion **203**.

The humidifying portion **202** may be a vaporization type in which wind is sent to a filter infiltrated with water or the like, water or the like is vaporized and humidified, an ultrasonic mist type of humidifying by ultrasonic mist, and a heating evaporation type in which water or the like is evaporated by heating and humidified. The relative humidity of the gas humidified by the humidifying portion **202** is, for example, 40% or more, and preferably 60%. The relative humidity of the gas humidified by the humidifying portion **202** is preferably such that the coarse crushing portion **12** does not condense.

The sheet manufacturing apparatus **200** has the humidifying portion **202** for supplying the humidified gas to the coarse crushing portion **12**. Therefore, in the sheet manufacturing apparatus **200**, drying of the coarse crushed piece cut by the coarse crushing blade **14** can be suppressed. As a result, in the sheet manufacturing apparatus **200**, it is possible to more reliably suppress the adhesion of the coarse crushed piece to the shooter **16** due to the electrostatic force.

2.2. Modified Examples of Sheet Manufacturing Apparatus

2.2.1. First Modified Example

Next, a sheet manufacturing apparatus according to a first modified example of the second embodiment will be described with reference to the drawings. FIG. **6** is a view schematically illustrating a sheet manufacturing apparatus **210** according to the first modified example of the second embodiment. Hereinafter, in the sheet manufacturing apparatus **210** according to the first modified example of the second embodiment, members having the same functions as those of the above-described sheet manufacturing apparatuses **100** and **200** are denoted by the same reference numerals, and a detailed description thereof will be omitted.

The sheet manufacturing apparatus **210** differs from the above-described sheet manufacturing apparatus **200** in that the sheet manufacturing apparatus **210** has a humidifying portion **204** as illustrated in FIG. **6**. The humidifying portion **204** is the humidifying portion **204** for humidifying the defibrated material (first sorted material sorted by the sorting portion **40**) that has passed through the opening of the sieve portion **41**. In the illustrated example, the humidifying portion **204** humidifies the web V on the mesh belt **46**. The humidifying portion **204** is provided above (on the sieve portion **41** side) with respect to the mesh belt **46**. The humidifying portion **204** may be the vaporization type, the ultrasonic mist type, or the heating evaporation type.

A suction mechanism **205** is provided below the mesh belt **46** (on the side opposite to the humidifying portion **204** side). The suction mechanism **205** can generate the air flow directed downward (directed from the humidifying portion **204** towards the mesh belt **46**). As a result, it is possible to humidify the web V uniformly in the thickness direction.

A pipe **302** is connected to the suction mechanism **205**. The pipe **302** forms a supply passage for supplying the gas humidified by the humidifying portion **204** between the coarse crushing portion **12** and the defibrating portion **20** (inside of the pipe **2**). The pipe **302** connects the suction mechanism **205** with the pipe **2**. In the illustrated example, the pipe **302** is connected to a connection portion between the first portion **2***a* and the second portion **2***b* of the pipe **2**. The gas humidified by the humidifying portion **204** passes through the inside of the pipe **302** and reaches the inside of the pipe **2**. The relative humidity of the gas humidified by the humidifying portion **204** is, for example, approximately 50%.

In the illustrated example, the pipe **2** is provided with a blower **310**. The pipe **302** is provided with a blower **312**. The

blowers **310** and **312** generate an air flow for supplying the gas humidified by the humidifying portion **204** into the pipe **2**.

The sheet manufacturing apparatus **210** has the humidifying portion **204** for humidifying the defibrated material (first sorted material) that passed through the opening of the sieve portion **41**. Therefore, in the sheet manufacturing apparatus **210**, it is possible to humidify the first sorted material, adhesion of the first sorted material to the mesh belt **46** due to the electrostatic force is weakened, the first sorted material is easily separated from the mesh belt **46**, and it is possible to prevent the first sorted material from adhering to the inner wall of the rotating object **49** or the covering portion **63** due to the electrostatic force.

The sheet manufacturing apparatus **210** has the pipe **302** forming the supply passage for supplying the gas humidified by the humidifying portion **204** between the coarse crushing portion **12** and the defibrating portion **20**. Therefore, in the sheet manufacturing apparatus **210**, the inside of the pipe **2** can be humidified by the gas humidified by the humidifying portion **204**. As a result, in the sheet manufacturing apparatus **210**, it is possible to prevent the coarse crushed piece passing through the inside of the pipe **2** and the defibrated material from drying and adhering to the inner wall of the pipe **2** due to the electrostatic force. Furthermore, in the sheet manufacturing apparatus **210**, the inside of the pipe **2** can be humidified by the gas humidified the first sorted material. As described above, in the sheet manufacturing apparatus **210**, the humidified gas can be recycled, and cost reduction can be achieved.

2.2.2. Second Modified Example

Next, a sheet manufacturing apparatus according to a second modified example of the second embodiment will be described with reference to the drawings. FIG. **7** is a view schematically illustrating a sheet manufacturing apparatus **220** according to the second modified example of the second embodiment. Hereinafter, in the sheet manufacturing apparatus **220** according to the second modified example of the second embodiment, members having the same functions as those of the above-described sheet manufacturing apparatuses **100**, **200**, and **210** are denoted by the same reference numerals, and a detailed description thereof will be omitted.

The sheet manufacturing apparatus **220** differs from the above-described sheet manufacturing apparatus **200** in that the sheet manufacturing apparatus **220** has a pipe **304** forming a supply passage for supplying the gas humidified by the humidifying portion **78** between the coarse crushing portion **12** and the defibrating portion **20** (in pipe **2**). The pipe **304** connects the suction mechanism **78***a* with the pipe **2**. In the illustrated example, the pipe **304** is connected to the connection portion between the first portion **2***a* and the second portion **2***b* of the pipe **2**. The gas humidified by the humidifying portion **78** passes through the inside of the pipe **304** and reaches the inside of the pipe **2**. The relative humidity of the gas humidified by the humidifying portion **78** is, for example, approximately 50%.

The humidifying portion **78** humidifies an accumulated material accumulated by the accumulation portion **60** (web W in the illustrated example). The accumulation portion **60** accumulates the defibrated material that passed through the opening of the sieve portion **61** on the mesh belt **72** (first sorted material sorted by the sorting portion **40**). The humidifying portion **78** may be the vaporization type, the ultrasonic mist type, or the heating evaporation type.

In the illustrated example, the pipe **304** is provided with a blower **314**. The blowers **310** and **314** generate an air flow for supplying the gas humidified by the humidifying portion **78** into the pipe **2**.

The sheet manufacturing apparatus **220** has the pipe **304** forming the supply passage for supplying the gas humidified by the humidifying portion **78** between the coarse crushing portion **12** and the defibrating portion **20**. Therefore, in the sheet manufacturing apparatus **220**, the inside of the pipe **2** can be humidified by the gas humidified by the humidifying portion **78**. As a result, in the sheet manufacturing apparatus **220**, it is possible to prevent the coarse crushed piece passing through the inside of the pipe **2** and the defibrated material from drying and adhering to the inner wall of the pipe **2** due to the electrostatic force. Furthermore, in the sheet manufacturing apparatus **220**, the inside of the pipe **2** can be humidified by the gas humidified the web W. As described above, in the sheet manufacturing apparatus **220**, the humidified gas can be recycled, and cost reduction can be achieved.

2.2.3. Third Modified Example

Next, a sheet manufacturing apparatus according to a third modified example of the second embodiment will be described with reference to the drawings. FIG. **8** is a view schematically illustrating a sheet manufacturing apparatus **230** according to the third modified example of the second embodiment. Hereinafter, in the sheet manufacturing apparatus **230** according to the third modified example of the second embodiment, members having the same functions as those of the above-described sheet manufacturing apparatuses **100**, **200**, **210**, and **220** are denoted by the same reference numerals, and a detailed description thereof will be omitted.

The sheet manufacturing apparatus **230** differs from the above-described sheet manufacturing apparatus **200** in that the sheet manufacturing apparatus **230** has humidifying portions **204**, **206**, and **208** as illustrated in FIG. **8**.

The humidifying portion (first humidifying portion) **206** humidifies the inside of the covering portion **63** of the accumulation portion **60**. The covering portion **63** covers at least a portion of the sieve portion **61**. The humidifying portion **206** may be the vaporization type, the ultrasonic mist type, or the heating evaporation type. The suction mechanism **76** can generate the air flow directed downward (directed from the humidifying portion **206** towards the mesh belt **72**). As a result, it is possible to humidify the web W uniformly in the thickness direction.

A pipe **306** is connected to the suction mechanism **76**. The pipe **306** forms a supply passage for supplying the gas humidified by the humidifying portion **206** between the coarse crushing portion **12** and the defibrating portion **20** (inside of the pipe **2**). The pipe **306** connects the suction mechanism **76** with the pipe **2**. In the illustrated example, the pipe **306** is connected to a connection portion between the first portion **2***a* and the second portion **2***b* of the pipe **2**. The gas humidified by the humidifying portion **206** passes through the inside of the pipe **306** and reaches the inside of the pipe **2**. The relative humidity of the gas humidified by the humidifying portion **206** is, for example, approximately 55%.

In the illustrated example, the pipe **306** is provided with a blower **316**. The blowers **310** and **316** generate an air flow for supplying the gas humidified by the humidifying portion **206** into the pipe **2**.

The humidifying portion (fourth humidifying portion) **208** introduces the humidified gas into the pipe **7**. The pipe **7** forms a transport passage (second transport passage) for transporting the first sorted material sorted by the sorting portion **40** to the accumulation portion **60**. The humidifying portion **208** may be the vaporization type, the ultrasonic mist type, or the heating evaporation type.

The sheet manufacturing apparatus **230** has the pipe **306** forming the supply passage for supplying the gas humidified by the humidifying portion **208** between the coarse crushing portion **12** and the defibrating portion **20**. Therefore, in the sheet manufacturing apparatus **230**, the inside of the pipe **2** can be humidified by the gas humidified by the humidifying portion **208**. As a result, in the sheet manufacturing apparatus **230**, it is possible to prevent the coarse crushed piece passing through the inside of the pipe **2** and the defibrated material from drying and adhering to the inner wall of the pipe **2** due to the electrostatic force. Furthermore, in the sheet manufacturing apparatus **230**, the inside of the pipe **2** can be humidified by the gas humidified the web W. As described above, in the sheet manufacturing apparatus **230**, the humidified gas can be recycled, and cost reduction can be achieved.

The sheet manufacturing apparatus **230** has the humidifying portion **208** for introducing the humidified gas into the pipe **7**. Therefore, in the sheet manufacturing apparatus **230**, the inside of the pipe **7** can be humidified by the gas humidified by the humidifying portion **208**. As a result, in the sheet manufacturing apparatus **230**, for example, it is possible to prevent the defibrated material from adhering to the rotating object **49** located in the pipe **7** due to the electrostatic force.

In the sheet manufacturing apparatus **230**, unlike the above-described sheet manufacturing apparatus **210** (refer to FIG. **6**), the gas humidified by the humidifying portion **204** is not supplied into the pipe **2**. This is because the paper dust generated from the web V is prevented from being supplied to the pipe **2** by the gas humidified by the humidifying portion **204**.

2.2.4. Fourth Modified Example

Next, a sheet manufacturing apparatus according to a fourth modified example of the second embodiment will be described with reference to the drawings. FIG. **9** is a view schematically illustrating a sheet manufacturing apparatus **240** according to the fourth modified example of the second embodiment. Hereinafter, in the sheet manufacturing apparatus **240** according to the fourth modified example of the second embodiment, members having the same functions as those of the above-described sheet manufacturing apparatuses **100**, **200**, **210**, **220**, **230** are denoted by the same reference numerals, and a detailed description thereof will be omitted.

The sheet manufacturing apparatus **240** differs from the above-described sheet manufacturing apparatus **200** in that the sheet manufacturing apparatus **240** has the humidifying portions **204**, **206**, **208**, and a pipe **308** as illustrated in FIG. **9**. The pipe **308** connects the pipe **2** with the suction mechanisms **76**, **78***a*, and **205**. The pipe **308** forms a supply passage for supplying the gas humidified by the humidifying portion **206** (first humidifying portion), the gas humidified by the humidifying portion **204** (second humidifying portion), and the gas humidified by the humidifying portion **78** (third humidifying portion) between the coarse crushing portion **12** and the defibrating portion **20** (in pipe **2**)

In the illustrated example, the pipe **308** has a sixth portion **308***a* extending in the horizontal direction, a seventh portion **308***b* connecting the sixth portion **308***a* with the suction mechanism **205**, an eighth portion **308***c* connecting the sixth portion **308***a* with the suction mechanism **76**, and a ninth portion **308***d* connecting the sixth portion **308***a* with the suction mechanism **78***a*. The sixth portion **308***a* is connected to the pipe **2** (connection portion between the first portion **2***a* and the second portion **2***b* of the pipe **2** in the illustrated example). The portions **308***b*, **308***c*, and **308***d* extend in the vertical direction. The seventh portion **308***b* supplies the gas humidified by the humidifying portion **204** into the sixth portion **308***a*. The eighth portion **308***c* supplies the gas humidified by the humidifying portion **206** into the sixth portion **308***a*. The ninth portion **308***d* supplies the gas humidified by the humidifying portion **78** into the sixth portion **308***a*.

In the illustrated example, the pipe **308** is provided with blowers **318***a*, **318***h*, and **318***c*. The blowers **310**, **318***a*, **318***b*, and **318***c* generate an air flow for supplying the gas humidified by the humidifying portion **78**, **204**, and **206** into the pipe **2**.

In the sheet manufacturing apparatus **240**, the pipe **308** forms a supply passage for supplying the gas humidified by the humidifying portion **78**, the gas humidified by the humidifying portion **204**, and the gas humidified by the humidifying portion **206**, between the coarse crushing portion **12** and the defibrating portion **20**. Therefore, in the sheet manufacturing apparatus **240**, it is possible to humidify the inside of the pipe **2** by the gas humidified by the humidifying portions **78**, **206**, and **208**. As a result, in the sheet manufacturing apparatus **240**, it is possible to further reliably prevent the coarse crushed piece passing through the inside of the pipe **2** and the defibrated material from drying and adhering to the inner wall of the pipe **2** due to the electrostatic force.

The sheet S manufactured by the sheet manufacturing apparatus according to the present invention mainly refers to a sheet formed into a sheet shape. However, the sheet S is not limited to a sheet shape, and may be in the form of a board or a web. The sheet in the specification is divided into a paper and nonwoven fabrics. The paper includes an aspect in which from pulp or waste paper as a raw material is formed into a thin sheet, and includes a recording paper for writing or printing, a wallpaper, a wrapping paper, a colored paper, a drawing paper, Kent paper, and the like. The nonwoven fabrics are thicker nonwoven fabrics than paper or low-strength nonwoven fabrics, and include general nonwoven fabrics, a fiber board, a tissue paper (tissue paper for cleaning), a kitchen paper, a cleaner, a filter, a liquid (waste ink and oil) absorbent material, a sound absorbing material, a heat insulating material, a cushioning material, a mat, and the like. As raw materials, vegetable fibers such as cellulose, chemical fibers such as polyethylene terephthalate (PET), polyester, animal fibers such as wool and silk may be used.

The present invention may omit a portion of the configuration within a range having the features and effects described in this application, or combine each embodiment and modified example. For example, in the sheet manufacturing apparatuses **200**, **210**, **220**, **230**, and **240**, the pipe **2** may have a curved shape like the sheet manufacturing apparatus **110** (refer to FIG. **4**). In addition, for example, in the sheet manufacturing apparatus **240**, the joint portion of the sixth portion **308***a* with the seventh portion **308***b* of the pipe **308** may have a curved shape like the pipe **2** of the sheet manufacturing apparatus **110**, and the joint portion of the sixth portion **308***a* with the eighth portion **308***c* of the pipe

308 may have a curved shape like the pipe **2** of the sheet manufacturing apparatus **110**.

The present invention includes substantially the same configuration as the configuration described in the embodiment (for example, configuration having the same function, method, and result, or configuration having the same object and effect). In addition, the present invention includes a configuration in which non-essential parts of the configuration described in the embodiment are replaced. In addition, the present invention includes a configuration that achieves the same operation and effect as the configuration described in the embodiment, or a configuration that can achieve the same object. In addition, the present invention includes a configuration in which a known technique is added to the configuration described in the embodiment.

The entire disclosure of Japanese Patent Application No: 2016-029094, filed Feb. 18, 2016 is expressly incorporated by reference herein.

REFERENCE SIGNS LIST

2 pipe
2*a* first portion
2*b* second portion
2*c* third portion
2*d* introduction port
3, **7**, **8** pipe
8*a* fourth portion
8*b* fifth portion
9 shooter
10 supply portion
11 subdivided object
12 coarse crushing portion
14 coarse crushing blade
16 shooter
20 defibrating portion
22 introduction port
24 discharge port
26 blower
40 sorting portion
41 drum portion
42 introduction port
43 housing portion
44 discharge port
45 first web forming portion
46 mesh belt
47, **47***a* stretching roller
48 suction portion
49 rotating object
49*a* base portion
49*b* projection portion
50 mixing portion
52 additive supply portion
54 pipe
56 blower
60 accumulation portion
61 drum portion
62 introduction port
63 housing portion
70 second web forming portion
72 mesh belt
74 stretching roller
76 suction mechanism
78 humidity conditioning portion
78*a* suction mechanism
79 transport portion
79*a* mesh belt
79*b* stretching roller
79*c* suction mechanism
80 sheet forming portion
82 pressing portion
84 heating portion
85 calendar roller
86 heating roller
90 cutting portion
92 first cutting portion
94 second cutting portion
96 discharge portion
100 sheet manufacturing apparatus
102 separation portion
104 fixing plate
105 air flow generation portion
106 detection portion
108 control portion
110, **200** sheet manufacturing apparatus
202 humidifying portion
203 storage portion
204 humidifying portion
205 suction mechanism
206 humidifying portion
210, **220**, **230**, **240** sheet manufacturing apparatus
302, **304**, **306**, **308** pipe
308*a* sixth portion
308*b* seventh portion
308*c* eighth portion
308*d* ninth portion
310, **312**, **314**, **316**, **318***a*, **318***b*, **318***c* blower

The invention claimed is:

1. A sheet manufacturing apparatus comprising:
a shredder that crushes a raw material containing a fiber into coarse crushed pieces;
a defibrator that defibrates the coarse crushed pieces into defibrated material;
a sieve portion that includes a plurality of openings;
a sheet forming portion, including a pair of calender rollers and a heater, that presses and heats defibrated material that has been defibrated at the defibrator and has passed through the plurality of openings to form a sheet;
a first pipe through which the coarse crushed pieces passes, the first pipe connecting the shredder to the defibrator;
a second pipe that defines a transport passage that transports defibrated material which has been defibrated at the defibrator and has not passed through the plurality of openings, the second pipe connecting the sieve portion to the first pipe;
a humidifier that humidifies the defibrated material that has been defibrated at the defibrator and has passed through the plurality of openings; and
a supply pipe that defines a supply passage that supplies gas humidified by the humidifier to inside of the first pipe.

2. The sheet manufacturing apparatus according to claim **1**, further comprising:
an additional humidifier that supplies humidified gas to the shredder.

3. The sheet manufacturing apparatus according to claim **1**, further comprising:
a drum sieve that accumulates the defibrated material that has been defibrated at the defibrator and has passed through the plurality of openings, wherein
the humidifier humidifies an accumulated material accumulated by the drum sieve.

4. A sheet manufacturing apparatus comprising:
a shredder that crushes a raw material containing a fiber into coarse crushed pieces;
a defibrator that defibrates the coarse crushed pieces into defibrated material;
a first drum sieve that sorts the defibrated material into a first sorted material and a second sorted material;
a second drum sieve that accumulates the first sorted material sorted by the first drum sieve;
a housing that covers at least a portion of the second drum sieve;
a sheet forming portion, including a pair of calender rollers and a heater, that presses and heats an accumulated material accumulated by the second drum sieve to form a sheet;
a connecting pipe through which the coarse crushed pieces passes, the connecting pipe connecting the shredder to the defibrator;
a first transport pipe that defines a first transport passage that transports the second sorted material sorted by the first drum sieve, the first transport pipe connecting the first drum sieve to the connecting pipe;
a first humidifier that humidifies an inside of the housing; and
a supply pipe that defines a supply passage that supplies gas humidified by the first humidifier to inside of the connecting pipe.

5. The sheet manufacturing apparatus according to claim 4, further comprising:
a second humidifier that humidifies the first sorted material sorted by the first drum sieve; and
a third humidifier that humidifies the accumulated material accumulated by the second drum sieve,
wherein the supply passage is a supply passage which supplies gas humidified by the first humidifier, gas humidified by the second humidifier, and gas humidified by the third humidifier to inside of the connecting pipe.

6. The sheet manufacturing apparatus according to claim 4, further comprising:
a second transport pipe that defines a second transport passage that transports the first sorted material sorted by the first drum sieve to the second drum sieve; and
a fourth humidifier that introduces humidified gas into the second transport passage.

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